

# Utilization of Papaver<sup>1</sup>

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*The well-known opium poppy (Papaver somniferum L.) furnishes opiates, ornamentals, poppyseed, poppyseed oil, poppycake, poppy flour, poppy straw and potherbs. Poppies also furnish analgesics, anodynes, ant food, antibiotics, anti-malarials, aphrodisiacs, baby rattles, bird food, copper indicators, cough remedies, demulcents, diaphoretics, diarrhea cures, febrifuges, fuel, fumitories, goiter treatments, hemostatics, hypnotics, imbedding media, indicators of the geographic origin of opium, molybdenum indicators, polyploidy inducers, salad vegetables, sedatives, sudorifics, tranquilizers and vesicants.*

## INTRODUCTION

An ethnobotanic or economic study of Papaver should focus on opium. Popov (1970) notes that although all members of the Papaveraceae are more or less poisonous, *Papaver somniferum* L. is most useful. Hoehne (1939) notes that no other medicinal or poisonous plant deserves more attention.

## HISTORICAL SKETCH

The opium poppy plant, well known in ancient Greece for its hypnotic qualities, was first regarded as a magic or poisonous plant used in religious rites, only later to be used in healing. The divinities Hypnos (Sleep), Nyx (Night) and Thanatos (Death) were portrayed with poppies. More than 350 years BC, Hippocrates mentioned poppy juice as cathartic, hypnotic, narcotic and styptic. By the 2nd Century AD, Galen states "opium is the strongest of the drugs which numb the senses and induce a deadening sleep; its effects are produced when it is soaked in boiling water, taken up on a flock of wool and used as a suppository; at the same time, some can be spread over the forehead and in the nostrils." Pliny the Elder mentioned that tablets made from the

nutritious seed were taken in milk as a hypnotic; that opium mixed with roseoil was used for headaches and for eyedrops; that mixed with woman's milk, it was applied to arthritics (as were the leaves); and that mixed with vinegar, it cured wounds and erysipelas. Several writers suggest that the gall added to the vinegar for Christ on the Cross was a poppy capsule to alleviate His final suffering.

## UTILIZATION

But for its narcotic properties, poppy might produce a variety of useful foods. Poppy seed are ground for porridge or used as a filling or glaze for cakes and pastries. They are rich in oil, carbohydrates, calcium, and proteins and have almost all essential amino acids except tryptophan (Bhown, Shah and Nath, 1965). The Council of Scientific and Industrial Research (CSIR, 1966) reports on seed analyses of five Indian poppy accessions: moisture, 4.3-5.2; protein, 22.3-24.4; ether extract, 46.5-49.1; N-free extract, 11.7-14.3; crude fibre, 4.8-5.8; ash, 5.6-6.0; calcium, 1.03-1.45; phosphorus, 0.79-0.89%; iron, 8.5-11.1 mg/100 g; thiamine, 740-1,181; riboflavin, 765-1,203; and nicotinic acid, 800-1,280 µg/100 g; carotene is absent. Minor minerals in the seeds include: iodine, 6 µg/kg; manganese, 29 mg/kg; copper, 22.9 mg/kg; magnesium, 15.6 g/kg; sodium, 0.3 g/kg; potassium, 5.25

<sup>1</sup> Paper presented at the 13th Annual Meeting of the Society for Economic Botany at the University of Mississippi.

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Submitted for publication March 5, 1973.

TABLE I  
SEED OIL AND PROTEIN CONTENT OF *PAPAVER* ACCESSIONS AS OF  
JANUARY 1, 1973

Species	Gm/1000 Seeds	Protein % N $\times$ 6.25	Oil %
<i>Papaver clavatum</i>	0.1	25.4	34.9
<i>Papaver dubium</i>	0.1	20.6	39.1
<i>Papaver fugax</i>	0.1	21.4	47.7
<i>Papaver hybridum</i>	0.1	27.2	34.6
<i>Papaver hybridum</i>	0.08	24.8	42.4
<i>Papaver monanthum</i>	0.2	25.5	47.7
<i>Papaver orientale</i>	0.2	22.9	45.4
<i>Papaver orientale</i>	0.4	24.4	46.7
<i>Papaver pavoninum</i>	0.1	27.5	44.0
<i>Papaver rhoeas</i>	0.2	27.3	40.1
<i>Papaver rhoeas</i>	0.1	21.7	42.3
<i>Papaver rhoeas</i>	0.2	26.9	45.1
<i>Papaver somniferum</i>	0.4	25.0	43.0
<i>Papaver somniferum</i>	0.4	21.8	47.6
<i>Papaver tauricola</i>	0.2	22.5	43.8

g/kg; and zinc, 130 mg/kg; the seeds also contain: lecithin, 2.80%; oxalic acid, 1.62%; pentosans, 3.0-3.6%; traces of narcotine and an amorphous alkaloid; and the enzymes diastase, emulsin, lipase and nuclease.

Rather similar oil and protein contents are reported from several poppy species besides the opium poppy. From the U.S. Department of Agriculture, A.S. Barclay provided data from the Department's seed-screening program to January, 1973 (Table I).

Schaaf (U.S. Patent 2,437,561) lists poppyseed oil among oils that have Vitamin F effects in skin treatments. Iodized poppyseed oil has helped curb goiter in Latin America (Kevany et al., 1969). Christensen (1954) proposed poppyseed oil as a low-refraction embedding medium for the microscopic study of pollen exines. Poppyseed oil has been important in manufacturing paints and varnishes (Balbi, 1960). Poppyseed oil cakes were estimated to have 88 feed units per 100 kg, 27.5% digestible crude protein and 25.6% digestible true protein (Jarl, 1946). Fed to cows and horses, 1.5 kg of oil cake per animal per day produced no ill effects, but reduced the fat content of milk and

gave the butter fat a somewhat weak consistency (Edin, Holloday and Nordfeldt, 1941). Bungler and Fissner (1941), finding no narcotic effects of poppyseed cake, reported little difference in milk and fat production. A feeding experiment in which 100 g of cake was given with 600 g of hay to sheep revealed the following digestion coefficients: organic matter, 54%; crude protein, 87%; crude fat, 100%; crude fiber, 0%; and N-free extract, 48%. Digestible nutrients contained in the feed were: organic matter, 44.1%; crude protein, 31.6%; true protein, 30.6%; crude fat, 1.8%; N-free extract, 10.8%; and ballast, 30.7%. Lezy (1946) reports that *Papaver setigerum* DC. straw caused cerebrospinal excitation in cattle. Lagneau and Gallard (1946) discuss the symptoms and treatment of such cattle.

Poppies serve for birdseeds. Birds are often pests in poppy fields. Marikovskii (1970) notes that poppyseed are the favorite food of ants raised in a formicarium.

Are poppy seeds poisonous? Tabor (1970) published a recipe that Langham wrote in 1579: "Powder of white Poppie seede given to children in milke or possite drinke, or an alebrew, or rather with a

Caudell of Almonds and hempe seede, causeth them to sleepe." Hemp and white poppyseed may have been part of a poison used by Lady Macbeth to drug Duncan's grooms. On the other hand, Popov (1970) says, "The seeds, particularly of the white varieties, contain no morphine."

Used in beverages in India, poppyseed could be addictive because of the presence of free serine. Fairbairn and El-Masry (1968) show that pepsin digestion of ground poppy seeds can result in codeine production. Although the seed coats contain no alkaloids, narceine, narcotine, papaverine and thebaine are detectable in the endosperm and embryo (Michels-Nyomarkay, 1970). Sarkany et al. (1967) found narceine, narcotine and thebaine in the endosperm. After a patient experienced beneficial sedative effects from ingestion of about 4 teaspoonfuls of poppy seed, Preininger, Vrublovsky and Stastny (1965) found codeine, morphine, narcotine, papaverine, rhoeadine and thebaine, but in amounts too small to explain the sedative effects. Acid hydrolysis frees the bound alkaloids in the seed (Fairbairn and El-Masry, 1968). Since infants fed on poppy milk show poor nitrogen retention, Niermann and Winter (1931) concluded it was unfit for infants.

In Scandinavia, poppies yield 580 kilos crude fat/ha and 300 kilos crude protein/ha (Nordestgard, 1960). Similar fields could also produce 2 kilos morphine/ha from poppy straw. It is reported that vernalization at relatively high temperatures increases essential oils, alkaloids and fats (Ohasi, 1962).

Seeds survive 16 months with no viability loss at 37% relative humidity and a corresponding seed moisture percentage of 5.6 (Sijbring, 1963). Vapor heating impairs the germinative capacity (Fujita et al., 1967).

For centuries opium has served as a tranquilizer. At first it served mainly for hysteria and hypochondria, then for mania, and more recently for melancholia. In the 19th Century, many doctors considered it the greatest pharmaceutical (Carlson and Simpson, 1963), but then morphinomania became recognized as a psychiatric disease.

Marihuana and hashish (Tennant et al., 1971) may be adulterated with opium, morphine or codeine. This is one way in which marihuana could be a gateway to opiates. Other ways include: (1) In Southeast Asia, opium-smoking hill tribes often grow marihuana as a hedgerow and add the leaves to their soups. (2) In India, one beverage combines marihuana seed, wine, poppyseed and opium. (3) In India, 80% of the people are attended by tribal doctors who use both marihuana and opium in their medicine kits. (4) Where both marihuana and opiates are illegal, they are likely to occur in the same illicit channels, so that users of one would associate with users of the other. The utilization of marihuana can conceivably lead to the utilization of opium.

Anand (1971) revives the old suspicion that an alcoholic extract of oat can be used in treating opiomania. *Cannabis* and *Scutellaria* (Day, 1872), *Argemone* (Dalziel, 1937), *Mitragyna* (Tyler, 1966), *Combretum*, *Blumea* and *Piscidia* (Lewin, 1964) have also been suggested as cures for morphinism. Yet in the past, the medical profession has advocated the use of opium as a treatment for chronic alcoholism and introduced heroin as a weapon against morphine addiction (Lennard, Epstein and Rosenthal, 1972). Juice of the leaves and stems of *Musa* are reported to be antidotal for opium overdoses. Substantial biochemical evidence indicates that addiction to ethanol is very similar to, if not identical with, addiction to opiates. Hwang (1970) notes a close correlation between opium and cholelithiasis. Disorders of the human tongue (Lyons, 1969) and the lung (Mazaud et al., 1963) are associated with opium smoking.

Dried capsules have been used for coughs in Europe, coeliac hypertension in ancient Greece, and diarrhea and coughs in China (Namba, 1965). The ripe capsule can be extracted with water and evaporated to obtain a product resembling opium (Fulton, 1944). Ancient Greeks used such tinctures for medicine or narcotics and the use of poppy "tea" continued long in folk medicine. Blyth and Blyth (1906, not seen; quoted by Fulton, 1944)

state that "the ignorant use of poppy tea has frequently caused the death of young children." A capsule the size of a small hen's egg may contain an average dose of morphine (Fulton, 1944).

In Peking, opium was in vogue as an aphrodisiac by 1550, but it probably was not adapted as an article of commerce for smoking until 1666. Macgowan (1859) concluded that poppy was not indigenous to China, otherwise the plant — its beauty lauded by poets, its flour described as lubricating the mouth, demulcent in the throat, harmonizing the lungs and nourishing the stomach — would have been faithfully recorded in the Chinese literature.

Near Canton, a citrus fruit, perforated for the addition of opium and then plugged, was carried in a rag for the perfume it exhaled. Gently warming caused the opium to diffuse through the fruit pulp. When needed, slices were shaved off for infusions to treat abdominal swellings, flatulence and diarrhea (Macgowan, 1859). Poppy flour mixed with glutinous rice or wheat flour is said to make good hot cakes, to which "bamboo drippings" may be added. Poppy leaves are used as salad. The "spring greens" are a good potherb; the stalks serve for fuel; "its roots enrich the soil"; ground seeds yield a nutritious meal and oil; the capsules are healing; and the leaves are extensively used to adulterate the poor man's tobacco. Even residual ashes of the smoked extract have some narcotic properties.

Southeast Asian Yao tribesmen that I observed have a most diverse intercropping. Among crops identified in poppy fields above a 28-family village north of Van Vieng, Laos, were amaranth, balsam pear, banana, (and related species), bean, betel, cabbage, chayote, Chinese radish, corn, cucumber, dill, eggplant, fennel, ginger, guava, kale, lemongrass, mint, mustard, onion, papaya, pea, pineapple, radish, string bean and possibly yardlong string bean, sugarcane, sweet potato, taro and yam bean.

Poppy seeds are broadcast periodically in November and December, the staggered seeding providing a staggered harvest.

Beginning in December, on the first day ripe pods are slit vertically on one side; on the second day the latex that exudes is scraped off near dawn; and on the third day the other side of the pod is lanced. Later the opium is mixed with water and boiled in a bronze pail, strained, boiled again until thick and kneaded. Seeds from the largest pods are retained for the next year's crop. Poisoned rice is placed near the seed to discourage rodents.

Meo tribesmen near Chiangmai, Thailand, planted opium in corn stubble with an occasional taro, a fruit tree or a pleasantly aromatic hedgerow of *Cannabis*. Opium is smoked and marihuana boiled in soups. The Meo and Yao I visited did not use poppy seed or seedlings for food. Westermeyer (1971), studying the Meo of Laos, found opium in every home; many smoke it, and few become addicted. At the volition of the individual, opium may be used as a medicine, for pleasure or (rarely) to commit suicide. "Even the habitual once-a-day smoker appears no more impaired physically or socially than the cocktail-before-supper suburbanite (Westermeyer, 1971)." Among the Lisu of Southeast Asia, seeds and young leaves are eaten, capsules are used for baby rattles and opium is smoked or eaten for malaria and applied externally for headaches (Dessaint, 1972).

Young plants are sometimes eaten like lettuce (reported also to serve as an opiate) and are grown as a potherb in Iran. Petals and sometimes leaves are used for packing opium. Leaves have been rubbed on the body as an anodyne (CSIR, 1966).

Indian legends associate opium and marihuana with the *Shaivite* and *Shaktey* cults. *Sadhus* and *yogis* of these cults use either or both to induce concentration. Arabian medicine was brought to India around the 9th Century AD by Muslims and became known as *Unani Tibbi*. *Unani* formulations containing opium are used for catarrh, conjunctivitis, dysentery, haemicrania and as an aphrodisiac. *Ayurvedic* formulations containing opium are used for diarrhea, insomnia and aphrodisia.

Ayurvedi describes the following properties of poppy: opium is aphrodisiac,

poppy seeds enhance capacity for muscular performance and promote the body luster, and the capsules cause impotency and dryness of the body. The capsules are said to cause nervous excitement, intoxication, garrulity, food reserve utilization and constipation. Seeds are considered tonic and aphrodisiac and are believed to allay nervous excitement and cause phlegm production. Opium is considered tonic, cleansing, binding and antiphlegmatic and is believed to cause biliousness, nervous excitement, dryness and mental confusion. The Unani Tibbi seems more factual, describing opium's action as analgesic, anodyne, constipative, febrifugal, hemostatic, hypnotic and retentive. Because 80% of the population is attended by Ayurvedi and Unani, it is difficult to recommend elimination of opium and marihuana without making available other less addictive alternatives.

In an article on addiction to post, a beverage made by crushing unlanced capsules in water, Chopra et al. (1930) mention an Indian beverage (*charbughra*) consisting of a mixture of wine, hemp, opium and poppy capsules. It is often "chased" by tea with sugar or powdered ginger or cardamoms, which could enhance the effects.

In Okinawa, opium is used to treat whooping cough, madness, spermatorrhea, diarrhea and fever; a decoction of the stem is used for stomachache and diarrhea (Tawada, 1951).

Decorative poppy stems should be cut as the calyces crack and the cut ends slightly scorched and placed in water. Not only the flowers are ornamental; capsules have been imported for decorative purposes. Gilded or painted, they were used for funereal and Christmas decorations (Fulton, 1944).

Kapustinskii (1950) reports that extracts of poppy flowers are active against human microorganisms such as *Micrococcus luteus* and *Myobacterium* and against plant pathogens of the *Peronosporaceae*.

Karp (1946) concluded that some *P. somniferum* is genetically determined to have no opium. Fulton (1944) hoped for development of an alkaloid-free variety for edible seed production. Miczulska

(1967) showed that in intraspecific hybrids, morphine content was intermediate or higher, whereas seed yields were 21 to 71% higher.

#### ALKALOIDS

Henry (1949) notes that some alkaloids depress, whereas others excite the central nervous system. Ascending from morphine to papaverine, codeine, narcotine and thebaine, the narcotic action diminishes and power of reflex stimulation increases until, with thebaine, the effect is a strychnine-like convulsion. Opium may contain 3 to 23% morphine, 0.1 to 2% papaverine, 0.1 to 4% codeine, 1 to 11% narcotine and 0.1 to 4% thebaine.

*Morphine* is a powerful analgesic, narcotic and stimulant. It depresses thalamus, sensory cortex, respiratory and cough centers; it stimulates the spinal cord, vagus and vomiting centers and the third nerve center; and it increases tone of involuntary muscles, especially in alimentary sphincters. It reduces secretions except for the skin glands. It induces euphoria (within 1/2 hour after hypodermic injection) with muscular relaxation, lessened physical activity, dimness of vision, loss of pain and hunger, slowing of respiration and contraction of pupils. Larger doses (15-20 mg) induce sleep and may cause nausea, delirium and convulsions. Still larger doses cause depression, unconsciousness, or even death. According to Malheiro-Garde (1950), morphine concentrations of 0.1%, 0.2% and 0.5% induce polyploidy and fragmentation in *Luzula purpurea* chromosomes. Morphine has been reported in *Papaver bracteatum*, *P. dubium* L., *P. hybridum* L., *P. rhoeas*, *P. setigerum*, *P. somniferum* and dubiously in *Argemone* and *Eschsholtzia*, but few if any of the reports are documented with voucher specimens. Villada (1893) reports studies confirming minute traces of morphine in *Argemone grandiflora*, *A. mexicana*, *A. ochroleuca*, but such observations have not been reconfirmed recently.

Kleinschmidt (1960) showed that labeled tyrosine was converted to both morphine and codeine in poppy. In

mature leaves, demethylation of codeine to morphine is uniform, there being no equilibrium between methylation and demethylation. Rapoport et al. (1960) discuss the interrelationships between thebaine, codeine and morphine. By root-feeding groups of opium poppy plants with labeled morphine, codeine and thebaine, Stermitz and Rapoport (1961) showed that thebaine was converted to codeine and codeine to morphine with ortho-demethylation as a metabolic pathway. Kirby (1967) confirmed the following biochemical sequence: tyrosine→salutaridinol-1→thebaine→codeine→morphine. Isolated latex can convert tyrosine to morphine. Kleinschmidt and Mothes (1958) report cultivating about 400 varieties of morphine-rich strains of poppy. During unfavorable years with high rainfall and low sunshine, straw of 80% of the varieties showed a maximum of only 0.2% morphine, but during good years straw of 40% of the varieties showed 0.2-0.3%, and straw in a few varieties consistently showed 0.4%. Of the 96 best varieties cultivated, only 1% showed up to 0.8-1% morphine. Andreev (1963) doubled yields of morphine via polyploidy. Triploids were especially rich in morphine. Opium samples inoculated with *Aspergillus* and incubated for a month lost morphine significantly, when compared with controls after 2 years (Pruner and Accadia, 1961). On the other hand, inoculating poppy broth with *Alternaria* increased the extractable morphine and codeine (Anon., 1968). Poppies can be ensiled or dried for the production of morphine and secondary alkaloids (narcotine, papaverine and thebaine). When suspended and dried at room temperature, 20% of the morphine is lost. When dried like hay in the field, 30% is lost. Siloing for 5 months is satisfactory (Roemisch, 1961). Of fertilizer taken up by poppy, 51.8% of N and 64.3% of P<sub>2</sub>O<sub>5</sub> appeared in the seed, whereas K and Ca appeared mostly in straw (Schroeder, 1966).

In its report for 1966, the United Nations for the first time distinguished between morphine manufactured from poppy straw and morphine manufactured from poppy straw concentrate. In 1966,

25.7 tons of morphine were manufactured from straw, 10.8 tons from poppy straw concentrate and 112.9 tons from opium. Poppy straw concentrate was manufactured in Argentina, Netherlands and Poland and used for morphine in Argentina, Australia, Belgium, Netherlands, Portugal, South Africa, Spain, Switzerland and the United Kingdom. The concentrate was exported by the Netherlands and Poland to Belgium, South Africa and Switzerland. Poppy straw was used for morphine in Argentina, Bulgaria, Czechoslovakia, East Germany, France, Hungary, Norway, Poland, Romania, USSR, the United Kingdom and Yugoslavia. Principal exporters of poppy straw were Australia, Belgium, France, Switzerland, Turkey and USSR. Principal importers were Belgium, Bulgaria, Czechoslovakia, France, Hungary, Italy, the Netherlands, Norway, Switzerland, the United Kingdom and West Germany. Although morphine from opium is said to be twice as expensive as that from capsules (Shuljgin, 1969), the percentage of morphine made from opium (as opposed to that from straw and concentrate) steadily increased from 63.5% in 1962 to 75.5% in 1966 [Bull. Narcotics 20(2): 50, 1968].

From the aqueous extract of 2,000 kg dry straw, from which the alkaloids were removed, Schmid and Karrer (1945) isolated p-hydroxybenzaldehyde, benzoic acid, fumaric acid, 2-hydroxycinchoninic acid, phthalic acid, hemipinic acid, m-hemipinic acid, p-hydroxycinnamic acid, p-hydroxystyrol, meconine and 5 other substances. Papaverine, codeine, narcotine, narcotoline, and thebaine can be obtained from "coalkaloid-benzene," a side product of the Kabay process (Bognar et al., 1969).

Rasmussen and Ilver (1945) report 2.5 tons straw/ha, or 2.5 kg anhydrous morphine/ha. In Russia, the morphine content of capsules varied from 0.4 to 0.9% with a dry morphine content approximating 2 kg/ha. Although there are reports of higher or lower morphine content, Bencze and Halmy (1948) found 0.459% morphine in the capsules of blue-seeded strains, 0.440% in gray-seeded and 0.458% in white-seeded.

*Papaverine*, with little narcotic or analgesic action, relaxes the involuntary muscles (intestinal, biliary, bronchial tree, urether, blood vessels). It slows the heart less than morphine or codeine. Intravenous injection increases cerebral blood flow but affects respiration little. It has been reported in *P. commutatum* Fisch. and Mey, *P. setigerum* and *P. somniferum*.

*Codeine* is less narcotic, constipating and euphoric than morphine. It stimulates the spinal cord and lower part of the brain less than morphine and depresses higher cerebral centers less. There is less sedation on respiratory centers than with morphine. Small doses are soporific, whereas large doses cause restlessness and increase reflex excitability. According to Ramana- than (1966), nearly 85% of the world's 120 tons of licit opium in 1960 was converted to codeine. Codeine is reported in *P. bracteatum* and *P. somniferum* and dubiously in *Argemone* and *Eschscholzia*.

*Narcotine*, the most abundant alkaloid after morphine, is a very mild narcotic and spinal stimulant. Falling between thebaine and codeine for convulsant activity, it accelerates respiration and has a colchicine-like action on mitosis. It has been reported from *P. rhoeas*, *P. setigerum* and *P. somniferum*.

*Thebaine* is convulsant rather than narcotic. Some of its pharmacological activities are discussed by Ishikawa (1927). In dogs, it acts as an anti-emetic. In large doses it may cause tetanic spasms (like strychnine) or may paralyze the peripheral motor nerves. Currently thebaine is an important source of narcotic antagonists sought to curb heroin addiction as antabuse curbs alcoholism.

In a cross between *P. somniferum* and *P. orientale*, the total alkaloid level, as well as codeine and thebaine, was higher in the  $F_2$  than in the  $F_1$  (Lorincz and Tetenyi, 1966). There are high- and low-thebaine strains in both *P. somniferum* and *P. orientale* sensu latu. Crossing high-thebaine *P. somniferum* with *P. orientale* to improve the morphine yield increased the morphine yield 2.2 times in the capsules and about 30 times in the root, with insignificant increases in the amount of thebaine (Böhm, 1966) (Chem. Abstr. 68:

47094c. 1968). Gross and Dawson (1963) showed how Tyrosine- $C^{14}$  supplied to *P. orientale* seedlings was incorporated into thebaine, oripavine and isothebaine. Thebaine was much more abundant than other secondary alkaloids in seedlings, suggesting that it is an intermediate in morphine-alkaloid metabolism in *P. bracteatum* (Pfeifer and Heydenreich, 1961). Spectrophotometric evidence suggested a shift from isothebaine to thebaine and oripavine production by the seedlings. In *P. somniferum*, thebaine content is variable in different organs in different stages. Decapitated plants accumulate more thebaine than normal plants, suggesting that the transformation of thebaine to codeine and morphine is inhibited by decapitation. Etiolated seedlings have a highly increased thebaine content (Neubauer, 1964). Mass production of seedlings *in vitro* could yield much thebaine. Thebaine has been reported in *P. argemone* L., *P. bracteatum*, *P. intermedium* DC., *P. orientale*, *P. oreophilum* Rupr., *P. pseudo-orientale* (Fedde) Medv., *P. rhoeas*, *P. setigerum*, *P. somniferum* and *P. strigosum* (Boenn.) Schur, but few if any of the reports are documented by voucher specimens.

#### OTHER POPPIES

*Papaver aculeatum* Thunb.

Watt (1967) notes that toxicity tests have proved negative and doubts that this species has any morphine-like narcotic properties.

*Papaver alpinum* L.

Seeds of the ornamental Alpine Poppy have been found in mammoth stomachs (Ridley, 1930).

*Papaver argemone* L.

An infusion or a syrup of petals of the Sand Poppy is used in Spain as a sudorific (CSIR, 1952-66). Capsules are sometimes a nuisance in wool (Ridley, 1930). This poppy is sometimes grown as an ornamental in Europe.

*Papaver bracteatum* Lindl.

Cullen (1968) states that most cultivated "oriental poppies" are the great

Scarlet Poppy, *P. bracteatum* (unique in that 98% of the total alkaloid is thebaine). In the second year, 30 kg thebaine/ha can be produced (Neubauer and Mothes, 1963). Latex from the pods contain up to 26% (dry weight) thebaine but no morphine (Sharghi and Lalezari, 1967). Böhm (1970) describes research to produce a thebaine-rich strain of *P. bracteatum*. If thebaine can be converted to codeine as cheaply as morphine can be converted and if *P. bracteatum* straw yielded 30 kg thebaine per ha on a sustainable basis (cf. 2 kg/ha morphine from poppy straw), *Papaver bracteatum* may be an attractive starting material for codeine and narcotic antagonists. The seeds, small and pleasantly flavored, like those of oriental poppy, are consumed in Iran. Because this species can be crossed with opium poppy, a hybrid strain could possibly be developed with good oil-seed qualities, high thebaine and no morphine.

#### *Papaver dubium* L.

In Australia, this annual is suspected to cause dermatitis and salivation in cattle. Elsewhere the petals are used as sudorific and the plant is used in homoeopathy. Aporeine is reported to be a tetanizing poison resembling thebaine in its action. It produces a burning and numbing sensation on the tongue (CSIR, 1966). Kazaryan and Della-Rossa (1967) hint that floral anomalies of this species indicate copper and molybdenum in the soil. The seeds, which weigh only 0.0208 grains, have been found in the crops of wood pigeons (Ridley, 1930). Schwerdfeger (1936) dispelled the belief that may beetles [*Melolontha hippocastani* (F.) and *M. Melolontha* L.] can be controlled by sowing *P. dubium*, *P. rhoeas* or *P. somniferum*. Occasionally *P. dubium* is grown as an ornamental, but in India it is considered a winter weed.

#### *Papaver floribundum* Desf.

This biennial is occasionally cultivated as an ornamental.

#### *Papaver fugax* Poir.

Kazaryan and Della-Rossa (1967) note that floral anomalies of this species indicate copper and molybdenum in the soil.

#### *Papaver glaucum* Boiss. and Haussk.

The annual Tulip Poppy is a popular ornamental with many of the alkaloids and the aroma of opium.

#### *Papaver hybridum* L.

The bristly capsules sometimes get entangled in wool. In Iraq, this is a weed in irrigated barley fields. Its juice is used to raise blisters (United States National Herbarium Collection).

#### *Papaver lacerum* Popov

Because the petals are sometimes completely black, this species is sometimes cultivated, perhaps more bizarre than ornamental.

#### *Papaver nudicaule* L.

Seeds of the Arctic perennial Iceland Poppy are used as a painkiller and tranquilizer by the Kalmucks, where opium poppy and other species are not available (Uphof, 1968). Flowers and capsules are mildly diaphoretic. The plant is said to poison sheep (CSIR, 1966). Seeds and pods are consumed by grouse (Ridley, 1930). At one time, this was an important cut flower in England (Anon., 1920).

#### *Papaver orientale* L.

Fulton (1944) reports that the small seeds of the perennial Oriental Poppy are probably as tasty as those of *P. somniferum*. Tournefort said that the Turks were accustomed to eat the green heads, though they are very bitter and acrid (Coats, 1968). Schroeder (1962) discusses its propagation as an ornamental. Thebaine is reported to be the predominant alkaloid during active growth, but at maturity the plant contains mostly isothebaine, which stimulates and later depresses the central nervous system (CSIR, 1966). Kazaryan and Della-Rossa (1967) report that floral anomalies in this species indicate copper and molybdenum in the soil. Pruner (1961) admixed latex of this



species with opium in attempts to determine the opium's origin.

*Papaver pavoninum* Fisch. and Mey.

The annual Peacock Poppy is sometimes cultivated as an ornamental.

*Papaver pilosum* Sibth. et Sm.

Olympic Poppy is a common ornamental, closely related to the oriental poppy.

*Papaver rhoeas* L.

Flowers of the Field Poppy are used as an expectorant and the petals for coloring wine (Uphof, 1968). The pollen, with unsaturated fatty acids constituting 91% of the total, is intensively sought by bees in Italy (Battaglini and Bosi, 1968).

Considered an autumn weed in Europe, Field Poppies can be controlled by dusting with 170 kg Ca/ha (Sunderlin and Gustafsson, 1946) (Biological Abstract 20886, 1946). Dried flowers of this well-known ornamental, avoided by cattle, contain rhoeadine and a little morphine (Popov, 1970). The mucilaginous petals are used for cough or hoarseness; they are also anodyne, sedative and sudorific. An infusion of the petals has been used like litmus, turning red with acid, blue with alkali. Bruised leaves are considered diaphoretic and are used for colds (Viguiet, 1814). Hakim, Mijovic and Walker (1961) state that eating the seeds might cause glaucoma. McNaughton and Harper (1964), blaming the toxicity on morphine and rhoeadine, report cattle and horse poisoning. In India, latex from the capsule is considered narcotic and sedative, like that of opium poppy in Europe (Puri, 1971). Seeds that weigh only 0.02135 grains each have been found in the crops of wood pigeons. They yield 22% of a non-toxic oil that resembles poppyseed oil (Awe, 1937). The Shirley Poppy, emblem of the American Legion, is a derivative of field poppy and has been important in the cut-flower trade.

*Papaver setigerum* DC.

Occasionally grown as an ornamental, this close relative of opium poppy contains some opium alkaloids. It has been implicated in cattle poisoning (Lezy, 1946).

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